USAID
FROM THE AMERICAN PEOPLE

Hydropower Investment Promotion Project (HIPP)

SUPPLY AND DEMAND PLANNING IN GEORGIA

AUGUST 2013

This publication was produced for review by the United States Agency for International Development. It was prepared by Deloitte Consulting LLP.

SUPPLY AND DEMAND PLANNING IN GEORGIA

AUGUST, 2013

USAID HYDROPOWER INVESTMENT PROMOTION PROJECT (HIPP)

CONTRACT NUMBER: EEM-I-00-07-00005-0

DELOITTE CONSULTING LLP

USAID/CAUCASUS OFFICE OF ENERGY AND ENVIRONMENT

~~MAY 28, 2013~~
August 12, 2013

This document was prepared by

Author	Organization	Contact Details
Dan Potash	Deloitte Consulting LLP	dpotash@deloitte.com
Reviewer	**Organization**	**Contact Details**
Jake Delphia	Deloitte Consulting LLP	jdelphia@deloitte.com

TABLE OF CONTENTS

Definition of Abbreviations

ACER	Agency for the Cooperation of Energy Regulators
ANSI	American National Standards Institute
AVR	Automatic Voltage Regulator
BSTP	Black Sea Transmission Project
CAISO	California Independent System Operator
CCA	Community choice Aggregators
CELT	Capacity Energy, Load, Transmission
CPUC	California Public Utilities Commission
EC	European Community
ENTSO-E	European Network of Transmission System Operators for Electricity (was formerly the UCTE)
ESCO	Electricity System Commercial Operator
ESP	Energy Service Providers
EU	European Union
FCA	Forward Capacity Auction
GDP	Gross Domestic Product
GEL	Georgian Lari (the currency)
GEMM	Georgian Electricity Market Model
GNERC	Georgian National Energy and Water Supply Regulation Commission
GoG	Government of Georgia
GSE	Georgian State Electrosystem
IOU	Investor Owned Utility
ISO	Independent System Operator
KPI	Key Performance Indicator
kV	Kilovolt
kWh	Kilowatt-hour
LSE	Load Serving Entity (same as a DSO, Distribution Syste erator)
LTPP	Utility Long Term Procurement Planning
MoE	Ministry of Energy
MENRP	Ministry of Environment and Natural Resources Protection
MoESD	Ministry of Economy and Sustainable Development
MoF	Ministry of Finance
MOO	Must Offer Obligation
MV	Medium Voltage
NRA	National Regulatory Authority or Agency
NYSIO	New York Independent System Operator
PJM	Pennsylvania, New Jersey, Maryland
PSS/E	Power System Simulator/Engineering
PU	Public Utility
RA	Resource Adequacy
RCST	Reliability Capacity Services Tariff
RES	Renewable Energy Sources
RMR	Reliability Must Run
ROI	Return on Investment
SB	Senate Bill (a kind of legislation in the U.S.)

SCADA	Supervisory Control and Data Acquisition
SEE	South East Europe
SO	Service Obligation
TEAIS	Turkish Electricity Transmission Company.
TSO	Transmission System Operator
USAID	United State Agency for International Development
VOLL	Value of Lost Load
W	Watt
Wh	Watt-hour

1.0 BACKGROUND

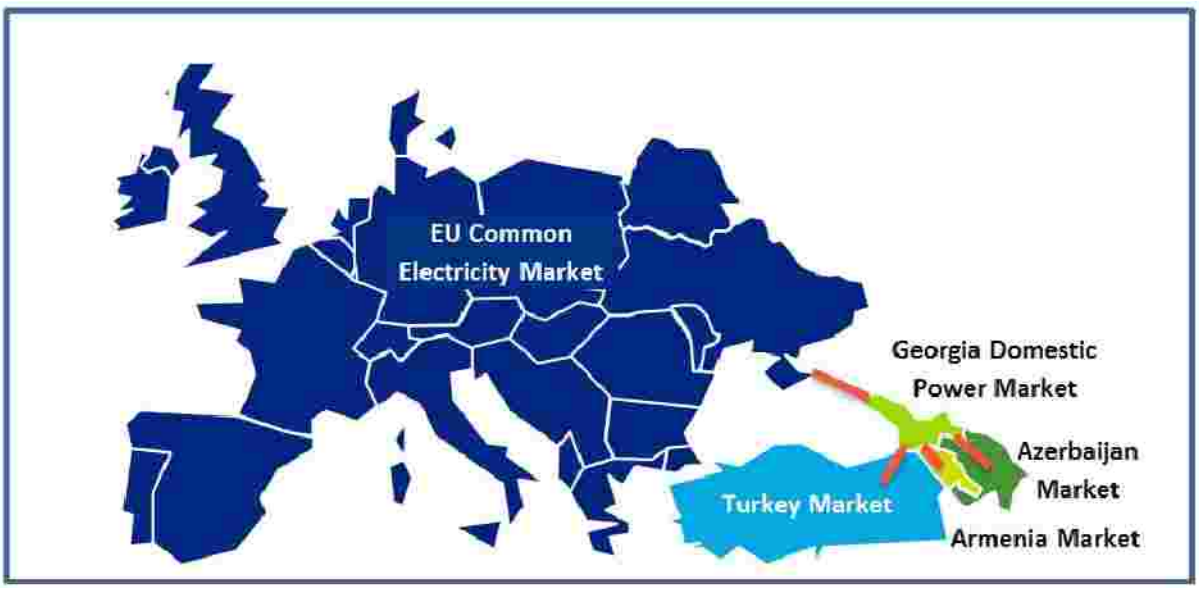
This document was compiled by a USAID-funded advisory project, Hydropower Investment Promotion Project, or HIPP. The HIPP project supports the Government of Georgia to attract investment from the private sector in modern, efficient hydropower plants. Since March 2010, HIPP has supported market-based initiatives to promote and secure international investments into Georgia's small and medium-sized hydroelectric power market.

This paper concerns the issue of power supply and demand planning issues in the context of Georgia implementing a competitive power market model ("Georgian Electricity Market Model, or GEMM). Georgia is introducing a competitive power market and is otherwise enhancing and reforming its electric power sector for four main reasons:

- To secure domestic power supply for Georgia's population and industry
- To avail significant private investment for export-oriented hydropower plants located in Georgia
- To engage in beneficial electricity trade with Georgia's immediate neighbors: Turkey, Azerbaijan, and Armenia
- To harmonize and connect with the European Energy Community for mutually beneficial electricity trade

In any modern country, the balancing of internal domestic power supply against domestic demand is a prime responsibility of government agencies and the Transmission System operator, or TSO, in the sense that government creates the framework of rules. Since the breakup of the former Soviet Union, Georgia has finally largely accomplished a balance of demand and supply, by rehabilitating physical power plants and distribution systems, building transmission infrastructure, and by pursuing utility sector commercial reforms. However, export opportunities for Georgia makes the supply and demand balancing more complicated for policy-makers and operators, and more profitable for private sector investors. Lucrative electricity markets in Turkey and Europe can be accessed by Georgian producers.

Figure 1: Electricity Markets



Since 2003, the EU has been making rules to create a common electricity market including cross-border trading. This has required that each EU Member Country, and other bordering countries, meet strict technical, legal, regulatory and financial standards. In 2011, Turkey joined the European Network of Transmission System Operators for Electricity and harmonized its legislation with EU directives to allow cross-border trading. Assuming that Georgia legislates and conforms with the EU rules, there is an attractive economic opportunity for Georgia to be a significant regional energy exporter.

In Figure 1, "Electricity Markets," Georgia is shown in bright green, north of Azerbaijan and Armenia, and northwest of Turkey. Georgia's immediate neighbors could potentially find great value from Georgia's hydroelectric resources. Turkey's electricity is largely fueled by natural gas and coal. Azerbaijan's power sector is largely run on oil and natural gas, and Armenia is run primarily on nuclear. From a utility planning viewpoint, Georgia's regional contrib ers valuable fuel diversity and cost reduction, especially as fossil fuel prices rise.

Also, the priority of renewable energy development in Europe may confer on Georgia's hydropower plants special higher value, because of the need caused by wind and solar intermittency for backup capacity reserves with some level of flexibility of delivery. Note in Figure 2: Planning Interrelationships, tha able Energy: Variable Energy Production" interacts with both minute-to-minute fluctuations with the grid, and with multi-year "Resource Adequacy and Procurement." This is true within a domestic market basis and also in a regional context.

Additional, more sweeping reforms are required by the EU in order to create a common market for electricity, offering economic choices and flexibility for producers and consumers. These additional reforms will require extensive changes concerning technical matters, new laws, and regulatory and financ improvements. Although the challenges are daunting, there are well-established formats and structures being developed worldwide, and specifically by the European Energy Community. There now is a body of experience from countries that have made the requisite changes in their power sectors, and have joined the EU common market structure, such as Bulgaria.

The EU acquis comunitaire[1] is concerned, inter alia, with three key aspects of planning: power supply and demand, investment in trans ission, and inducting renewable energy generation into the supply portfolio.

Note in Figure 2, "Planning Interrelationships," that these three areas of planning interrelate with other planning and operating activities.

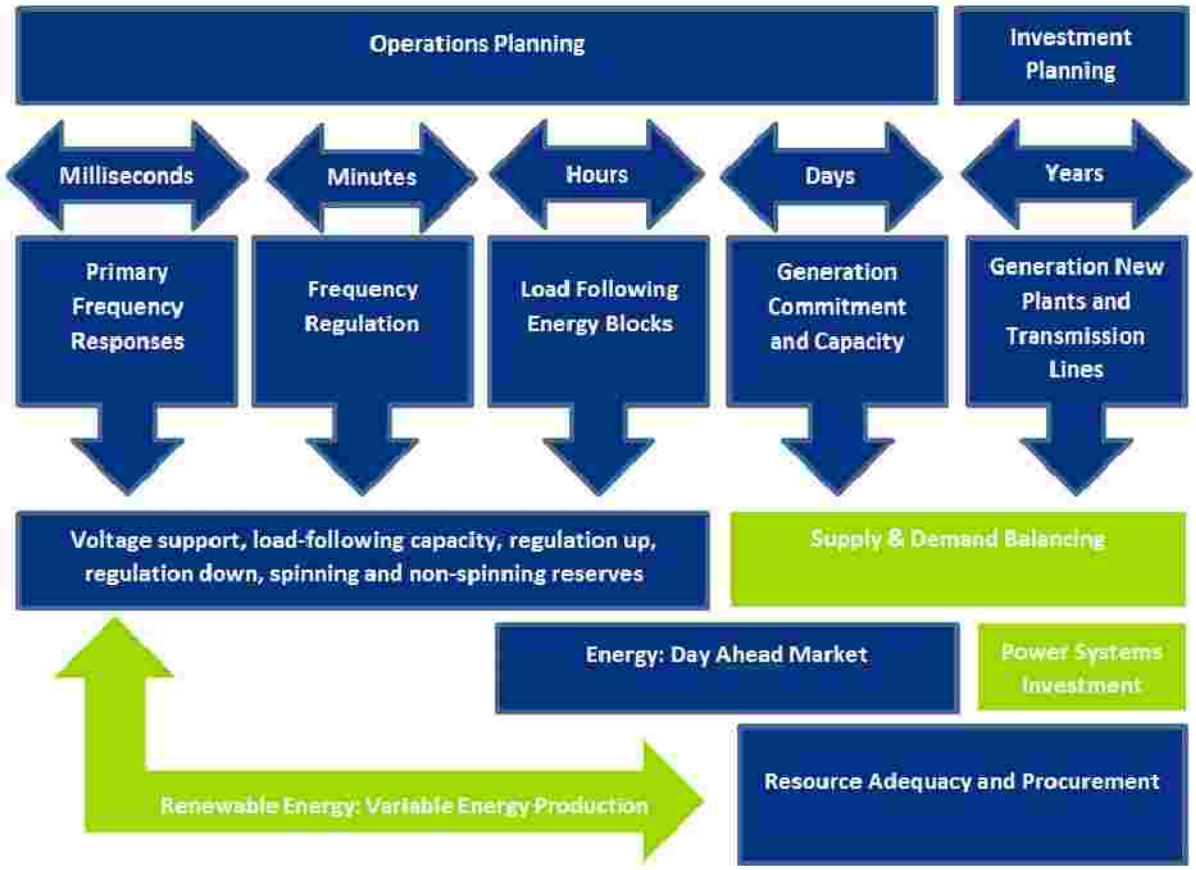
[1] In Georgia as well as all over Europe, officials use the term "acquis comunitaire," or simply the "acquis." From the Eurofound, EU agency: "Acquis communautaire is a French term referring to the cumulative body of European Community laws, comprising the EC's objectives, substantive rules, policies and, in particular, the primary and secondary legislation and case law – all of which form part of the legal order of the European Union (EU). This includes all the treaties, regulations and directives passed by the European institutions, as well as judgements laid down by the European Court of Justice. The acquis is dynamic, constantly developing as the Community evo ves, and fundamental. All Member States are bound to comply with the acquis communautaire. The term is most often used in connection with preparations by candidate countries to join the Union. They must adopt, implement and enforce all the acquis to be allowed to join the EU. As well as changing national laws, this often means setting up or changing the necessary administrative or judicial bodies which oversee the legislation."

1.1.1 LESSONS LEARNED IN COMPETITIVE MARKETS

Georgia is a young country, with a high-growth economy.[2] The economies of the E.U. and the U.S. are slower growing and not as dynamic[3], and as a result, electric power demand in the E.U. and U.S. are growing relatively slowly. Also, energy efficiency is lowering power demand in E.U. and U.S. Therefore the existing fleet of generation plants in the E.U. and in the U.S. is able to keep up with demand for an increasingly longer time frame, in the planning horizon.

The U.S. and the E.U. are both implementing competitive power markets, including capacity markets that are intended to provide incentives for new power generation. Both are finding that implementing a competitive capacity market is much trickier. In a country like Georgia, the context of planning for, and implementing power supply has to be done faster.

Figure 2: Planning Interrelationships



The green shaded componnets in the above graph show the relationship of the power demand and supply in the planning.

Power supply and demand is a complex planning issue when evaluated in an isolated system, and it becomes even more complex when the system is interconnected for international power transactions. A key element of planning for power supply and demand is that within a "control area," supply and demand need to be adequately balanced. Control area means a physical area that power sector

[2] Georgia had 6.5% growth rate of GDP in 2012 according to World Bank, World Development Indicators.

[3] U.S. had 2.2% growth rate of GDP in 2012 according to World Bank, World Development Indicators. The E.U. had -0.3%

managers can independently schedule adequate generation and meet consumer demand, and which can be an entire country or part of country. While there can be temporary advantageous trading opportunities, the EU requires (and it is considered worldwide best practice) that power sector managers need to be able to meet local demand with locally produced resources.

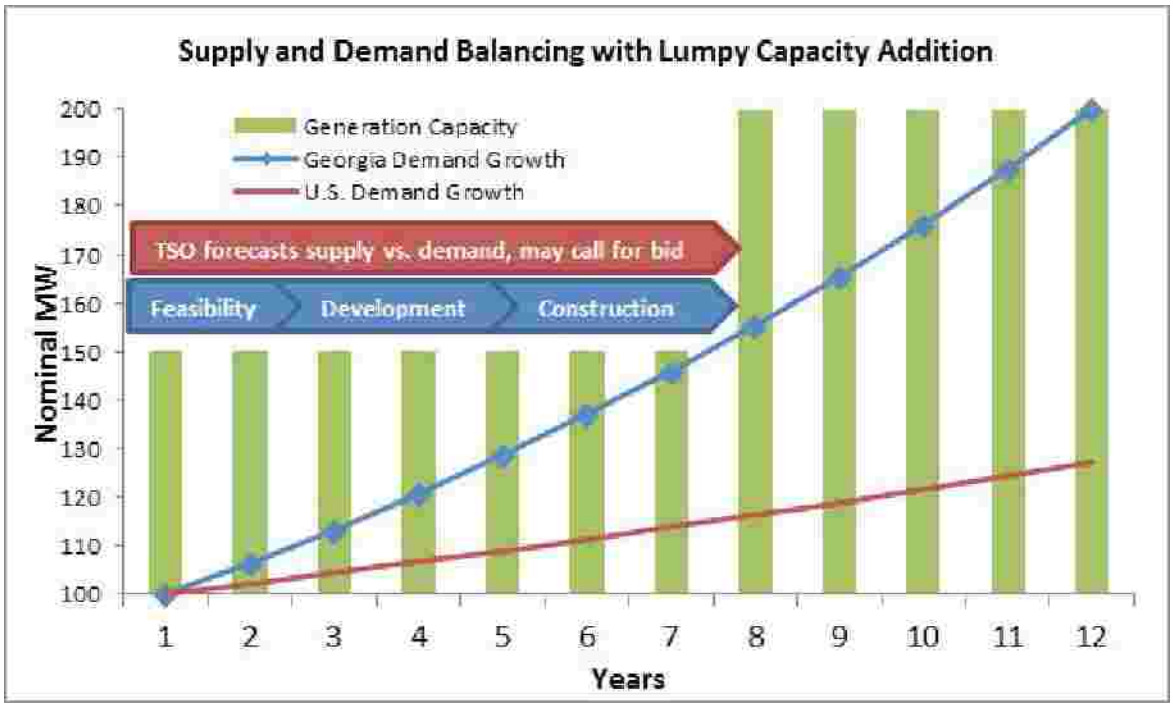
Regarding Supply and Demand balanacing, Georgian policy-makers need to take near-term and medium-term actions. This document outlines more detail about three areas of concern. It provides the current status regarding each issue in Georgia, the relevant worldwide best practices and EU requirements, uggested plan for activities for Georgian policy-makers, regulators, and power systems operators.

Power demand and supply is not just about planning but also assessment, implementation, and enforcement in the case of deficient performance. Also, there is a big issue about which entitites are involved and the sequence of steps in balancing power supply.

1.1.2 PLANNING TIME SCALE

The time scale to bring on new generation is many years in duration. Especially in a high growth environment, this puts pressure on the time scale for development. The following chart shows why this is a problem.

The chart shows two lines depicting demand growth, one is high growth case of Georgia at 6.5% and lower case U.S. at 2.2%. The columns are depicting power capacity, which jumps from a nominal 100 MW to 200 MW in year eight. To balance supply and demand it is assumed that 100 MW is added in year eight. In order to cause this addition in year eight, note that the start of feasibility of a project has to begin in year zero. The development of the project is making all the contractual arrangements (Power Purchase Agreement ("PPA"), Equipment Procurement and Construction ("EPC"), Operation and Maintenance ("O&M"), and transmission, balancing, financing, etc.)



Note in this graph that the blue line is Georgia, showing that the eight year total frame just fits in with demand growth. Note in the red line below, there is not any need for new capacity in the 12 year time frame of thi is.

Supply and demand planning in Georgia has to be done faster than in slower growth markets such as EU and U.S.

2.0 SUPPLY AND DEMAND: GEORGIA CURRENT STATUS

a) GSE Annual Report
   i) The Report covers GSE's Strategic Development Plan, for enhanced reliability and dispatch infrastructure and export capability. Power supply is growing relative to power demand, which has been flat. GSE estimates that 50-60 million MWh of hydropower per year is economically feasible to develop, as compared with about 10 million MWh per year of consumption. Clearly, the main planning problem of GSE, is accommodating export volumes and as much meeting demand.

b) Laws, decrees, regulatory orders, governing GSE planning responsibilities
   i) Grid Code Chapters 3 and 4 concerns long-term and short-term planning, respectively. The Grid Code is under development with support from HIPP project. There is not a clear picture when the entirety may be adopted, perhaps in 2014.
      (1) Grid Code Chapter 3 elaborates planning processes that are consistent with best practices and EU requirements and with best practices elaborated below.
      (2) However, the proposed Grid Code is most focused on dom ic supply and demand balance rather than planning for addressing the business opportunity presenting in the regional market.
   ii) Georgian Government Resolution #193, of July 15, 2010: ining the Guaranteed Capacity and Guaranteed Capacity Sources in Electric Energy System of Georgia; establishes the minimum capacity levels for certain Georgian power plants.
   iii) Electricity (Capacity) Market Rules, approved by MoE on August 30, 2006.

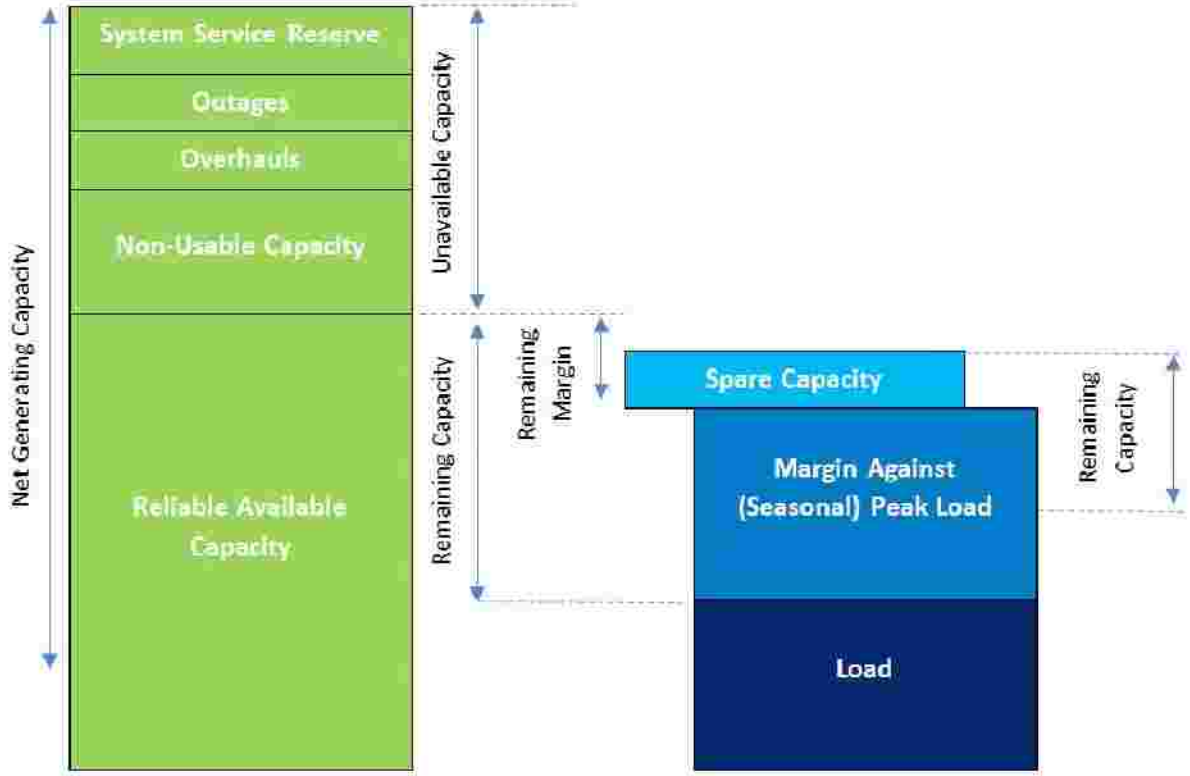
c) What are investment planning responsibilities of other stakeholders:
   i) Regulator, GNERC, Georgian National Energy and Water Supply Regulatory Commission has the responsibility to regulate the power sector. GNERC considers itself to have responsibilities for overall energy sector planning, though it delegates to GSE the respon ilities for forecasting and matching power supply and demand in the medium term.

d) Tendering for new electricity capacity has been evolving. Since the Market Rules were first established in 2008, private power producers were allowed to enter the market, but the enabling environment has not favorable enough to motivate significant interest in potential investment. Some elements of this would include transmission access, capacity allocation, tariff methodology, balancing arrangements, and many other factors important to investors.

3.0 EU REQUIREMENTS

The European Network of Transmission System Operators for Electricity, ("ENTSO-e") has a schema for analyzing generation adequacy, which is rendered as followed in Figure 5. Each Member State calculates and manages ion adequacy, taking into account imports and exports.

Figure 3: ENTSO Schema for Electricity Reserves[4]



System strategic reserves are considered to be capacity reserves that are procured but kept off the market except in times of extreme emergency. In those situations, those power plants act as setting price caps in a competitive market.

Otherwise, in order remunerate capacity, there can be either a capacity payment based on price per kW of available capacity that can be a variable amount, or a payment for a fixed amount of capacity under normal market circumstances.

ENTSO-E anticipates that Member States should deploy a market solution for adding generation necessary to meet demand. However, there is not a specific single modality for the process to add generation. The two main methodologies for doing so are: 1) letting the market indicate price motivate self-organized investment in generation, or, 2) administratively determining that a capacity shortfall might be coming, and running a formal tender to add capacity. Also ENTSO-E recognized that despite the best designs, there may be a market failure, i.e. the prices signals (and/or other risk evaluation) that does not sufficiently motivate investment in generation capacity.

[4] European Commission Consultation Paper on generation adequacy, capacity mechanisms and the internal market in electricity 11/15/2012

Finally, there is strong recognition on the part of policy makers that capacity may be added by program of demand response. Smart metering llow customers to effectively add capacity by cutting usage as indicated by price signals. However, getting these mechanisms robustly incorporated into the market is not easy for supply and demand planners.

The ENTSO-e Consultation Paper says that “development and implementation of EU wider network codes is also an important part of delivering generation adequacy. Networks codes establish the “playing field” for market participants. The network codes that relate to generation adequacy and demand and supply balancing are:

- Electricity balancing
- Load frequency control and reserves

The network code relating to “Forward Capacity Allocation,” is referring to allocation of transmission capacity, not to be confused with the ISO New England, FCA, “Forward Capacity Auction” for generation.

The EU Directive 2009/72 of the European Parliament and of the Council, 13 July 2009 concern common rules for the internal market in electricity, with the following points regarding supply and demand:

i) Planning: Formulate national energy action plans, ensuring long-term ability of the system to meet reasonable demand through investment planning.

ii) Article 4 of Directive 2009/72 requires Member States to monitor security of supply and to produce bi-annual reports about the security of supply.

iii) Article 8 concerns tendering for new capacity.

(1) Member States shall ensure the possibility, in the interests of security of supply, of providing for new capacity or energy efficiency / demand-side management measures through a tendering procedure or any procedure equivalent in terms of transparency and non-discrimination, on the basis of published criteria. Those procedures may, however, be launched only where, on the basis of the authorization procedure, the generating capacity to be built or the energy efficien mand-side management measures to be taken are insufficient to ensure security of supply.

(2) Member States may ensure the possibility, in the interests of environmental protection and the promotion of infant new technologies, of tendering for new capacity on the basis of published criteria. Such tendering may relate to new capacity or to energy efficiency/demand-side management measures. A tendering procedure may, however, be launched only where, on the basis of the authorisation procedure the generating capacity to be built or the measures to be taken, are insufficient to achieve those objectives. Details of the tendering procedure for means of generating capacity and energy efficiency/demand-side management measures shall be published in the Official Journal of the European Union at least six months prior to the closing date for tenders.

(3) The tender specifications shall be made available to any interested undertaking established in the territory of a Member State so that it has sufficient time in which to submit a tender.

(4) With a view to ensuring transparency and non-discrimination, the tender specifications shall contain a detailed description of the contract specifications and of the procedure to be followed by all tenderers and an exhaustive list of criteria governing the selection of tenderers and the award of the contract, including incentives, such as subsidies, which are covered by the tender. Those specifications so relate to the fields referred to in Article 7(2).

(5) In invitations to tender for the requisite generating capacity, consideration must also be given to electricity supply offers with long-term guarantees from existing generating units, provided that additional requirements can be met in this way.

(6) Member States shall designate an authority or a public or private body independent from electricity generation, transmission, distribution and supply activities, which may be a regulatory authority referred to in Article 35(1), to be responsible for the organisation, monitoring and control of the tendering procedure referred to in paragraphs 1 to 4 of this Article. Where a transmission system operator is fully independent from other activities not relating to the transmission system in ownership terms, the transmission system operator may be designated as the body responsible for organising, monitoring and controlling the tendering procedure. That authority or body shall take all necessary steps to ensure confidentiality of the information contained in the tenders.

c) Regulation (EC) No 714/2009 of the European Parliament and of the Council, 13 July 200; On Conditions for Access to the Network for Cross-Border Exchanges in Electricity. In particular, Article 8 addresses 10-year investment plan including generation adequacy.

d) Directive 2005/89/EC establishes measures aimed at safeguarding security of electricity supply so as to ensure the proper functioning of the internal market for electricity and to ensure:

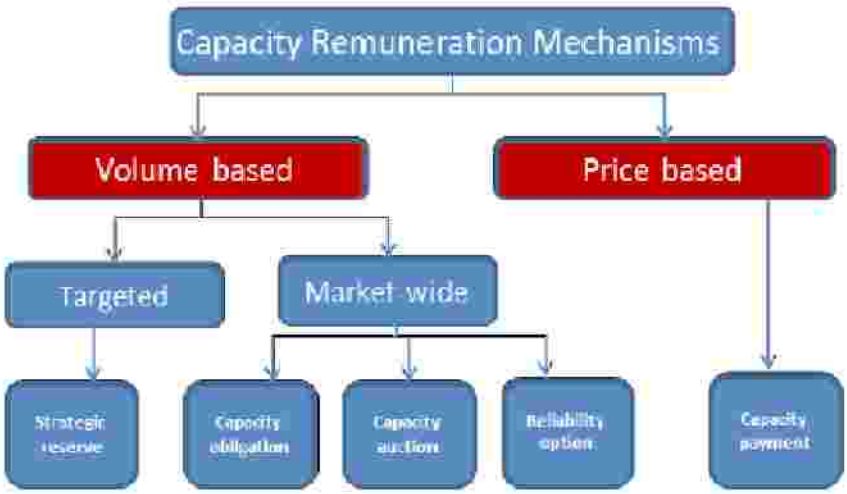
   i) an adequate level of generation capacity;
   ii) an adequate balance between supply and demand;
   iii) Member States shall take appropriate measures to maintain a balance between the demand for electricity and the availability of generation capacity, but:
      (1) Encouraging the establishment of a wholesale market framework that provides suitable price signals for generation and con mption; and
   iv) Require transmission system operators to ensure that an appropriate level of generation reserve capacity is available for balancing purposes and/or to adopt equivalent market based measures.

e) The ACER issued a report, “Capacity Remuneration Mechanisms And The Internal Market For Electricity, July 2013, in which it adopted the position that a capacity market was required in order to induce new investments in generation. According to the report, “There is, however, a growing concern in several EU Member States (“MSs”) that electricity markets, with increasing shares of (intermittent) renewable electricity generation, will not be able to

deliver sufficient capacity to meet electricity demand at all times in the future. The political sensitivity to blackouts, as well as pra cal and theoretical uncertainties2 as to if and when investors will build new generation capacity"

ACER studied "Capacity Remuneration Mechanisms," separate from energy markets. Below in figure 4 are the mechanisms they studied.

Figure 4: ACER Breakdown of Capacity Remuneration Mechanisms



ACER did not take a position on which method Capacity Remuneration Mechanism was preferred, however, it is a becoming a consensus view that an energy-only market will not motivate sufficient investment in supply.

4.0 SUGGESTIONS FOR GEORGIAN ELECTRICITY SUPPLY AND DEMAND PLANNING

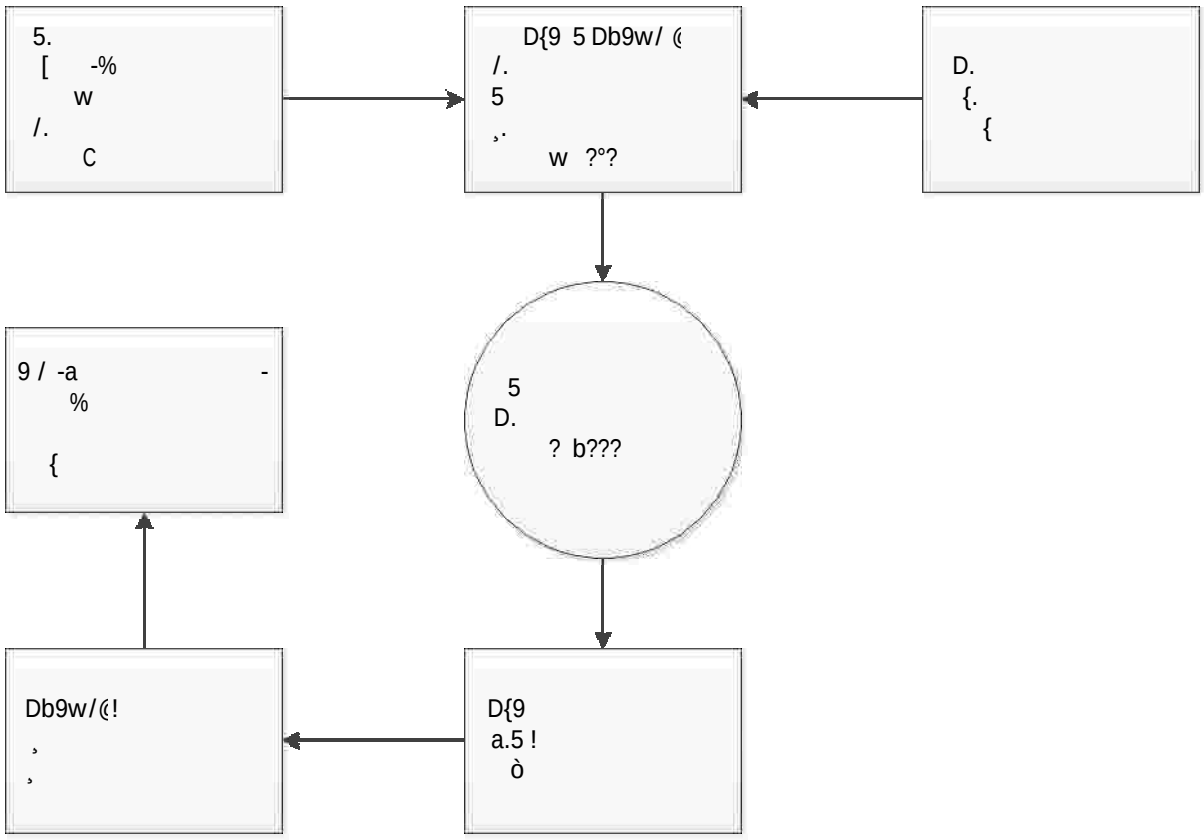
Georgia might consider several ways to balance supply and demand, as follows:

1. GSE monitors resource adequacy by evaluating reserve margin and runs a capacity auction
2. GNERC monitors Load-Serving Entitites for KPI's on outages, service interrupitons,and allows LSE's to make bilateral contracts to keep KPI's within a suitable range.
3. Pure market approach where high prices in energy market provide incentive for investors to increase generation investment or "merchant" transmission line accessing new supply.

Option 2 may too much for GNERC to administer. Option 3 could likely lead to unacceptable political results such as price spikes and load-sheedding. Option 3 is therefore recommended.

A simplified version of the recommended supply and demand planning and assessment by GSE may be shown as follows:

Figure 5: Suggested Supply and Demand and Reliability Planning



Balancing electricity supply and demand is not just te ical matter but also requires expertise in the spheres of legal, financial and econo ic matters. As it regards secondary legislation necessary to implement EU framework with respect to, the MoE and GNERC must each have specialized expert knowledge on EU legislation

as each must complete different types of legislation compliant with EU energy acquis. More information on this will be known upon co letion of the final Energy Community roadmap agreed between the GoG and the EU.

Specific next steps may include:

a) GNERC and GSE develop procedures to assess, plan, process and price the acquisition of suitable levels of reserve capacity. These steps need to be consistent with EU Directives, Regulations, and rules set forth by the ENTSO-E. Help design competitive procurement plan to drive down capacity acquisition costs while also protecting domestic consu ers from supply withholding in winter. Ascertain how to let market clearing prices inform investment decisions while maintaining adequate and safe levels of reserve margins.

b) GSE should undertake a thorough audit and analysis of the current electricity planning process, and, through better coordination or information exchange with other major stakeholders (including GoG agencies in charge of economic growth or regional development, international donors, private sector and research organizations), identify all useful or necessary elements that are crucial for effective technical planning that bears on electricity supply and demand. This can involve making a “data book” forming the agreed-upon economic and weather-related assumptions that bear on electricity supply and demand. Weather data would include daily temperature, nd speed, rainfall, timing of sunrise and sunset. Besides accounting for econometric data annually, peak demand would be correlated to the day of the week (i.e., whether it is a weekday or weekend) plus accounting for holidays. While such forecasting is highly detailed, it is critically important to account for peak demand because of the steep price of energy shortages, either in terms of the high price of marginal supply, or in terms of the high economic value of lost load.

c) GSE should produce capacity-building workshops in Tbilisi and also bring Georgian officials on study tours where markets have been expanded and inter-country trade has grown significantly, notably Bulgaria. Also, assist with study tours and harmonization tours for utility company officials to attend suitable conferences and workshops with EU energy officials and ENTO-E officials.

d) MoE needs to explore policy analysis, options, examples, on power market and tariff allocation to domestic customers versus exports. Consider creative approaches to demand/supply balancing such as financial firming, demand side management, smart metering, which may enhance Georgian economic opportunities.

e) GNERC should evaluate role of long term supply demand balancing, in light of distribution companies entering into bilateral contracts with generators and traders, .i.e., GNERC may issues guidelines on prudency, speed, transparency, adequacy and mainly the procurement procedures of wholesale supply contracts. This work must dovetail with GNERC’s oversight of ESCO transitioning from a “single-buyer” market to one of long-term bilateral contracts plus a balancing market.

f) GSE should undertake load forecasting in four ways:

i) Conventional single-country econometric and weather-related load forecast plan for Georgia. Specifically, assistance should be obtained to enhance technical planning capacities within GSE (TSO) through strengthening in-house forecasting and planning capabilities and improve coordination with other stakeholders.

ii) Enhanced load forecast plan with non-linear growth attributes (i.e. impact of sharply increased use of air conditioning), consider track record of other fast-growing economies with structural similarities of high levels of remittances and high levels of growth in remittances.

iii) Enhanced load forecast plan with international multi-country power trade, bi-lateral, regional and Southeast Europe and pan-Europe. Forecast of demand in Turkey should be done on a fairly detailed basis, coordinating with appropriate ministries and with TEAIS, Turkish Electricity Transmission Company.

iv) Evaluate the opportunity for specialized load support delivered in Turkey and the EU for other electricity market products, such as load-following capacity, regulation up, regulation down, spinning and non-spinning reserves (after joining ENTSO-e). This might include enhanced load forecast plan based on green power integrated EU supply and demand, consider impact of nuclear and coal decommissioning; consider Georgian opportunity for firm power replacement.

USAID Hydropower Investment Promotion Project (USAID-HIPP)

Deloitte Consulting Overseas Projects - HIPP

11 Apakidze Street, Tiflis Business Center

Tbilisi, 0171, Georgia